

Investigation of Local Structures Around Ge in MBE-Grown Si/Ge Superlattices with “Inverted Hut” Structure of SiGe Nanocrystals

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Local structures around Ge in Si/Ge superlattices grown by MBE have been investigated by using the extended x-ray absorption fine structure (EXAFS) technique. In contrast to the hut clusters of Si-Ge nanosized dots grown on top of Si layers using the conventional Stranski-Krastanow (SK) self-organized growth mode, samples grown by an innovative growth mode have exhibited “inverted hut” structure of Si-Ge nanocrystals in the Si layers at relatively lower growth temperatures. To understand the mechanism of the formation of such “inverted huts”, samples with different Ge wetting layer thickness have been studied. It was found that the number of Ge-Si bonds per unit volume in these samples is much higher than that calculated from the Si/Ge superlattice structures with clear Si-Ge interfaces. In fact, our EXAFS data suggest the existence of an intermixing zone of about 2-3 monolayers on each side of the Si/Ge interface in these Si/Ge superlattice samples. The intermixing of atoms could be utilized to relieve the strain energy caused by the Si-Ge lattice mismatch at the interface and hence leads to the formation of the “inverted hut” nanocrystals.

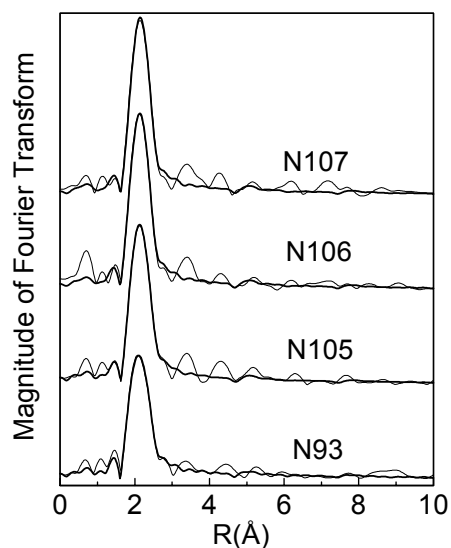


Figure 1. Fourier transform of EXAFS χ functions. Fine lines: experimental; thickness coarse lines: curve-fitting

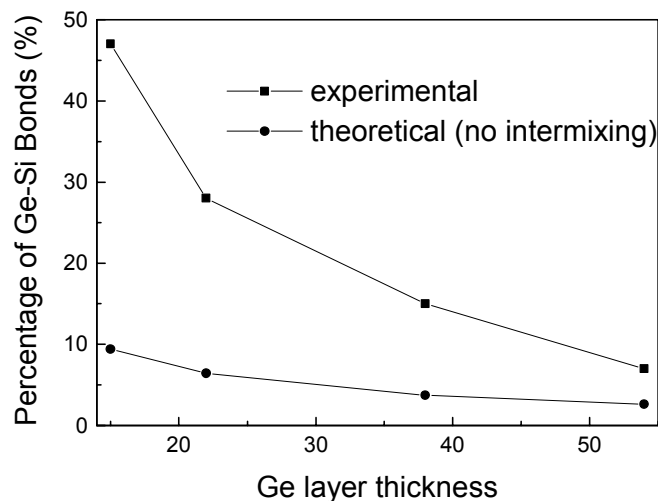


Figure 2. Percentage of Ge-Si bonds vs. Ge layer

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